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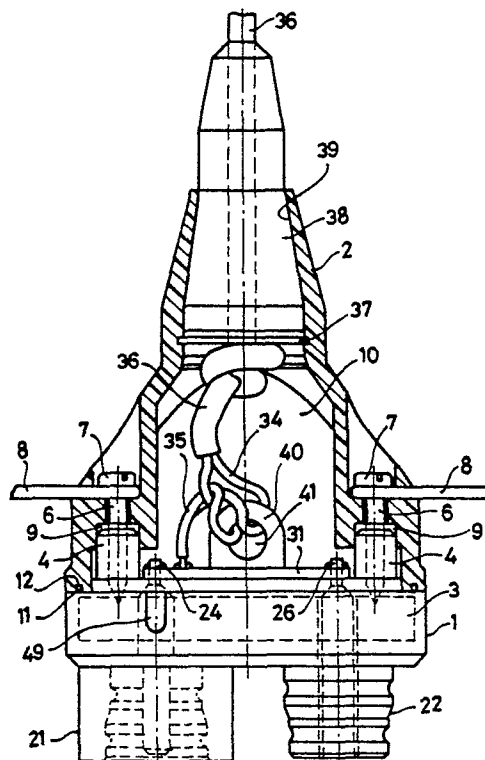
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⑤④ Connector with internal electrical connections to be made optionally.

⑤⑦ Connector comprising at least two groups of electrically conducting elements of pins (17, 18) and sleeves (19, 20) respectively, said elements (17-20) being fixed at distance of each other to a fixing piece (3) in a cavity (10) formed by a base part (1) and a closure part (2), and to conductor tracks of a printed wiring card (31, 31') provided in said cavity - (10) at the fixing piece (3). Conductors (34, 35) of a cable (36) fed from the extension into said cavity - (10) are connected to said conductor tracks. Dependent on the arrangement of the conductor tracks on said card (31, 31') different electrical schemes of electrical devices, in particular strings of geophones, can be obtained.



**FIG. 2.**

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Connector with internal electrical connections to be made optionally.

The invention relates to a connector comprising a casing having within the casing at least two groups of electrically conducting connecting elements led through a fixing piece and fixed to the fixing piece, which connecting elements each have at one end thereof a pin or a sleeve, the pins and/or sleeves of each group being disposed at a distance from each other and parallel to each other and exposed to the environment in a respective coupling section for the respective group so that an electrically conducting connection can be obtained with a corresponding group of matching connecting elements of another unit, and respective conductors of a cable led into the casing from outside being connected to respective connecting elements. The invention relates in particular to a connector for use in the field of seismic exploration, each group comprising two connecting elements and the cable having two conductors which are connected to the respective connecting elements and which may be connected outside the connector to a string of geophones. One coupling section of the connector may be coupled to another connecting unit which is connected to a main cable which leads to a measuring and control unit. The other coupling section of the connector may be coupled to another connector, optionally via an extension cable provided with coupling pieces at the ends thereof.

A connector of this type is known from the US Patent 4,445,741. In the known connector the connecting elements consist of two parallel rods disposed next to each other which each have a sleeve at one end and a pin at the other end. The rods are fixed at a relatively large distance from the ends of the rods in the centre of a fixing piece. Each of the conductors are led in a loop through passages formed in the fixing piece and the ends of the conductors are fixed to the rods. The rods, the fixing piece and an end section of the cable are received in a sealing manner in a rubber casing cast in a manner such that a coupling section of one connector can be plugged in a sealing manner into a coupling section of another connector or of another connecting unit, a pin being plugged into a sleeve to obtain an electrical contact at the same time. In another embodiment of this known connector one of the two groups of connecting elements of a connector comprises only pins and another group comprises only sleeves. For use in the field of seismic exploration one group of connecting elements comprises in this case a thick pin and a thin pin for two different polarities and the other

group comprises a sleeve with large inside diameter and a sleeve with small inside diameter respectively for polarities which correspond to the respective pins.

The known connector has as a disadvantage the fact that it is not suitable for electrically connecting strings of geophones in series if a number of connectors are coupled to each other and each cable emerging from a connector is connected to a string of geophones.

Because the coupling sections of the known connectors are formed at the ends of the connecting elements formed by rods, if a number of connectors of this type are coupled in series, a corresponding number of strings of geophones being electrically connected with each other in parallel, a long rod of connectors merging into each other is produced. When used in the field the connecting elements, in particular the sleeves, may easily be damaged under these circumstances by bending of the rod.

The object of the invention is to eliminate the disadvantages of the known connector.

The invention therefore provides a connector of the type mentioned in the introduction which distinguishes itself therefrom in that the groups of connecting elements are fixed at a distance from each other to the fixing piece in a manner such that all the pins and sleeves extend parallel to each other on one side of the fixing piece, and that the connecting elements are connected at the fixing piece to conductor tracks provided on a printed wiring card. In this connection a choice can be made from various printed wiring cards which each have conductor tracks provided according to a specific pattern for the respective wiring card. For a given printed wiring card the pins and sleeves with the same polarity can therefore be connected via the conductor tracks to each other and to a respective conductor of the cable so that if a number of connectors are coupled together the strings of geophones connected to the respective cables are electrically connected in parallel. With another printed wiring card the connecting elements of one polarity can be connected via a conductor track to each other and the connecting elements of the other polarity can each be connected to a respective conductor of the cable so that if a number of connectors are coupled to each other the strings of geophones connected to the cables are connected in series. In the last case the connecting elements of one of the coupling sections of the last connector in the series chain have to be short-circuited,

which may take place by means of a suitable pattern of the conductor tracks inside the said connector itself or by means of a separate short circuiting connector suitable therefor.

Since the connectors can all be coupled to each other close to each other, the connecting elements all being within a relatively small area, damage to the connecting elements when used in the field is counteracted.

Because the connector according to the invention is suitable for being constructed with different printed wiring cards, the connector is preferably constructed in such a manner that the casing consists of a base part and a closure part which are fixed to each other in a sealing manner and at the same time form a hollow cavity, the fixing piece being disposed in the base part and the cable being led into the cavity in a manner such that the conductors of the cable are connected in the cavity to the connecting elements and/or the conductor tracks. As a result of this, assuming identical base parts and identical closure parts, by using different printed wiring cards correspondingly different connectors can be obtained. At the same time the end sections of cables with different diameters can be received in the hollow cavity of the connector.

In addition, the base part and the closure part are preferably to be detachably fixed to each other. As a result the connector is not only modular but also constructed in a demountable fashion, it being possible to replace defective parts thereof. Even if, as a result of too great a tensile force being exerted on the cable, the electrical connection of the conductors of the cable to the conductor tracks or to the connecting elements is disturbed, or if the cable outside the connector is damaged, these defects can be repaired with the connector being retained. In addition, the cable may be formed by the connection cable of a single geophone or of a string of geophones, the said cable being cut to the correct length and can be connected directly, i.e. without coupling pieces, to the respective connecting elements inside the connector.

In order to relieve the conductors inside the connector for tension, the connector is preferably constructed in a manner such that the closure part consists of rigid material, that the closure part has a passage with a bearing edge, between the cavity to be formed with the base part and the environment, for a rigid ring disposed in the cavity, that the section of the passage increases in the direction of the cavity, and that there is disposed in the passage a grummet of flexible material which extends to outside the closure part and the section of which inside the passage touches the wall of the passage, the cable being led out of the cavity via

the ring and the grummet to the outside and the cable having a barrier piece resting on the ring which counteracts movement of the cable towards the outside.

To provide a tension relief for the conductors inside the connector it is preferable, in addition, that the fixing piece has a tag extending through a recess of the printed wiring card and having an eyelet therein and that the conductors of the cable are wrapped with one or more windings around the edge of the eyelet.

The invention is explained by reference to the drawing. In the drawing:

Figure 1 shows a view of the connector according to the invention with the closure part thereof in section;

Figure 2 shows a bottom view of the connector of Figure 1;

Figure 3 shows a view of the base part of the connector of Figure 1 provided with a fixing piece and printed wiring card;

Figure 4 shows a plan view of the base part of Figure 3;

Figure 5 shows a section of the base part along the line V-V of Figure 4;

Figure 6 shows a section of the base part along the line VI-VI of Figure 4;

Figure 7 shows a view of the fixing piece of the connector of Figure 1;

Figure 8 shows a plan view of the fixing piece of Figure 7;

Figure 9 shows a section of the fixing piece along the line IX-IX of Figure 8;

Figure 10 shows a section of the fixing piece along the line X-X of Figure 8;

Figure 11 shows a plan view of the printed wiring card of the connector of Figure 1;

Figure 12 shows a bottom view of the printed wiring card of Figure 11;

Figure 13 shows a plan view of another embodiment of the printed wiring card of the connector of Figure 1;

Figure 14 shows a bottom view of the printed wiring card of Figure 13;

Figure 15 shows a diagrammatic representation for the coupling of a number of connectors provided with printed wiring cards to obtain strings of geophones connected in parallel;

Figure 16 shows a diagrammatic representation of the electrical connections which are obtained in the coupling according to Figure 15;

Figure 17 shows a diagrammatic representation for the coupling of a number of connectors with a different printed wiring card for obtaining a series connection of strings of geophones, and

Figure 18 shows a diagrammatic representation of the electrical connections which are obtained for the coupling according to Figure 17.

The connector shown in Figure 1 comprises a base part 1 of flexible rubber and a closure part 2 of hard insulating material. The base part 1 comprises a fixing piece 3 of hard insulating material. The closure part 2 and the fixing piece 3 may consist of nylon. The fixing piece 3 has projections 4 which extend into the closure part 2 and in which a hole 5 with internal screw thread is formed. The base part 1 and the closure part 2 are fixed to each other by means of screws 6 screwed into the holes 5. Between the head 7 of a screw 6 and a bearing edge of the closure part 2 next to a passage for the screw 6 there is disposed an end section of a card 8 of a dust cap (not shown). Between the closure part 2 and the top face of the respective projection 4 the screw 6 passes through a ring 9 which consists of flexible material and which provides a seal for the cavity 10 formed between the base part 1 and the closure part 2. At the edge of the closure part 2 the base part 1 has a circumferential rib 11 which engages flexibly in a matching groove 12 of the closure part 2.

The fixing part 3 is provided with four passages 13, 14, 15, 16 disposed in the corners of a rectangle. In the passages 13, 14 pins 17 and 18 respectively are gripped. In the passages 15 and 16 sleeves 19 and 20 respectively are gripped. The inside diameters of all the passages 13-16 are different to prevent interchanging of the pins and sleeves during the assembly.

The pins 17, 18 and the sleeves 19, 20 form the connecting elements of the connector and are disposed in rubber coupling sections 21 and 22 respectively, which each have matching grooves and ribs at the circumference, in a manner such that a coupling section 22 of a connector can be plugged into a coupling section 21 of another connector in a sealing manner and at the same time the pins 17, 18 can be plugged into the sleeves 20 and 19 respectively of the coupling section 22 so that between the respective pins and sleeves an electrical contact is obtained.

The centre distance a between the pins 17, 18 is at the same time larger than the centre distance b between the sleeves 19, 20. The centre distance a is, for example, 12% larger than the centre distance b.

The inside diameters of the sleeves 19, 20 are larger, for example, by 3.5% than the diameters of the pins 18 and 17 respectively to be connected to said sleeves.

The section of each pin 17, 18 which is gripped in the fixing piece 3 is thicker than the rest of the pin, in particular the section which can be plugged into a sleeve, in order to counteract the disadvantageous effect of a loosening movement. On the side of the closure part 2 the ends of the pins 17, 18 and sleeves 19, 20 are each formed by a small rod 23, 24, 25 and 26 respectively which passes through openings 27, 28, 29 and 30 respectively of a printed wiring card 31 which is disposed on the side of the closure part 2 against the fixing part 3. The printed wiring card has yet another system of openings 32, 33 to allow through the bare ends of the conductors 34 and 35 respectively of a cable 36 which is led into the cavity 10 via a ring 37 and a grummet 38 of flexible material from outside the connector. In the end section of the cable 36 there is disposed a barrier, in particular in the form of a knot in the cable, which prevents the cable 36 being pulled out of the connector. The shape of the grummet 38 and the wall 39 of the closure part, with which the grummet 38 is in contact, are such that as a greater force originating from the connector is exerted on the cable 36, the grummet 38 is increasingly clamped against the wall 39, a radial force being exerted on the cable 36 in the passage in the grummet 38 so that the pulling of the cable 36 out of the cavity 10 is counteracted. In order to relieve the cores 34, 35 of the cable 36 separately for tension the fixing piece 3 is provided with a projection 40 with a passage 41, which projection extends via a central recess

42 in the printed wiring card 31 into the cavity 10 of the closure part 2. The conductors 34 and 35 can then be passed several times through the hole 41.

The printed wiring card 31 has on one side a conductor track 43 which encompasses the openings 27 and 30 for connecting the pin 17 to the sleeve 20, and had contact surfaces 44, 45 for the pin 18 and the sleeve 19 respectively. On the other side of the card 31 there is disposed a conductor track 46 for connecting the pin to the sleeve 19, while contact surfaces 47 and 48 are provided for the pin 17 and the sleeve 20 respectively. The hole 27 to 33 incl. are plated through. The conductor tracks 43 (or 46) and conduct surfaces 44 and 45 - (or 47 and 48) are not shown in Figure 4 in connection with clarity.

As explained with reference to Figures 15 and 16, the printed wiring card 31 shown in Figures 11 and 12 is suitable for the electrical connection in parallel of a number of strings of geophones which each have at the end of a cable 36 a connector of the type shown in Figure 1.

Figures 13 and 14 show another embodiment of the printed circuit card 31' which, as explained with reference to Figures 17 and 18, is suitable for the electrical connection in series of a number of strings of geophones which each have at the end of a cable a connector as shown in Figure 1.

It is assumed that all the thick pins 18 and wide sleeves 19 form connections with positive polarity and that all the thin pins 17 and narrow sleeves 20 form connections with negative polarity. The positive polarity is indicated by means of thickenings 49 on the outside of the base part 1.

Figure 15 shows a number of identical connectors 50 which are each provided with the printed wiring card 31 shown in Figures 11 and 12 and the electrical connections of which inside the connector 50 and the locations of the sleeves and pins are shown diagrammatically. As shown, the connectors 50 are coupled in series in a manner such that a coupling section 22 of one connector 50 is always plugged into a coupling section 21 with pins 17, 18 of another connector 50. In this case the conductors 34, 35 of the cables 36 of the different connectors 50 are connected in parallel with each other. The uppermost coupling section 22 or the lowermost coupling section 21 shown in Figure 15 can be connected via another suitable connector to a main cable which leads to a measuring and control unit.

Figure 16 shows diagrammatically the electrical connections brought about according to the coupling of Figure 15.

The connectors 50' shown in Figure 17 are identical to the connectors 50 except that instead of the printed circuit card 31 the card 31' shown in Figures 13 and 14 is fitted in each connector 50'. The connectors 50' are coupled to each other in the same way as explained with reference to Figure 15. A short circuit connector 51 with a coupling section 22 having shortcircuited sleeves is in this case plugged into the coupling section 21 of one of the two end connectors 50' of a group of connectors 50'. As shown diagrammatically in Figure 18, with the coupling procedure of Figure 17 a series connection is obtained of strings of geophones connected to the respective connectors 50'.

It is pointed out that the geophones of each string of geophones connected to a cable 36 can be connected with each other and with the conductors 34, 35 of the cable 36 according to an arbitrary arrangement.

**Claims**

1. Connector comprising a casing having within the casing at least two groups of electrically conducting connecting elements led through a fixing piece and fixed to the fixing piece, which connecting elements each have at one end thereof a pin or a sleeve, the pins and/or sleeves of each group being disposed at a distance from each other and parallel to each other and exposed to the environment in a respective coupling section for the respective group so that an electrically conducting connection can be obtained with a corresponding group of matching connecting elements of another unit, and respective conductors of a cable led into the casing from outside being connected to respective connecting elements, characterized in that the groups of connecting elements are fixed at a distance from each other to the fixing piece (3) in a manner such that all the pins (17, 18) and sleeves - (19, 20) extend parallel to each other on one side of the fixing piece, and that the connecting elements are connected at the fixing piece (3) to conductor tracks provided on a printed wiring card (31, 31').

2. Connector according to Claim 1, characterized in that the casing consists of a base part (1) and a closure part (2) which are fixed to each other in a sealing manner and at the same time form a hollow cavity (10), the fixing piece (3) being disposed in the base part (1) and the cable (36) being led into the cavity (10) in a manner such that the conductors (34, 35) of the cable (36) are connected in the cavity (10) to the connecting elements and/or to the

conductor tracks.

3. Connector according to Claim 2, characterized in that the base part (1) and the closure part (2) are detachably fixed to each other.

4. Connector according to claims 2 or 3, characterized in that the closure part (2) consists of rigid material, that the closure part (2) has a passage with a bearing edge, between the cavity (10) to be formed with the base part (1) and the environment, for a rigid ring (37) disposed in the cavity (10), that the section of the passage increases in the direction of the cavity (10), and that there is disposed in the passage a grummet (38) of flexible material which extends to outside the closure part (2) and

the section of which inside the passage touches the wall (39) of the passage, the cable (36) being led out of the cavity (10) via the ring (37) and the grummet (38) to the outside and the cable (36) having a barrier piece resting on the ring (37) which counteracts movement of the cable (36) towards the outside.

5. Connector according to one of the preceding claims, characterized in that the fixing piece (3) has a tag (40) extending through a recess (42) of the printed wiring card (31, 31') and having an eyelet (41) therein and that the conductors (34, 35) of the cable (36) are wrapped with one or more windings around the edge of the eyelet (41).

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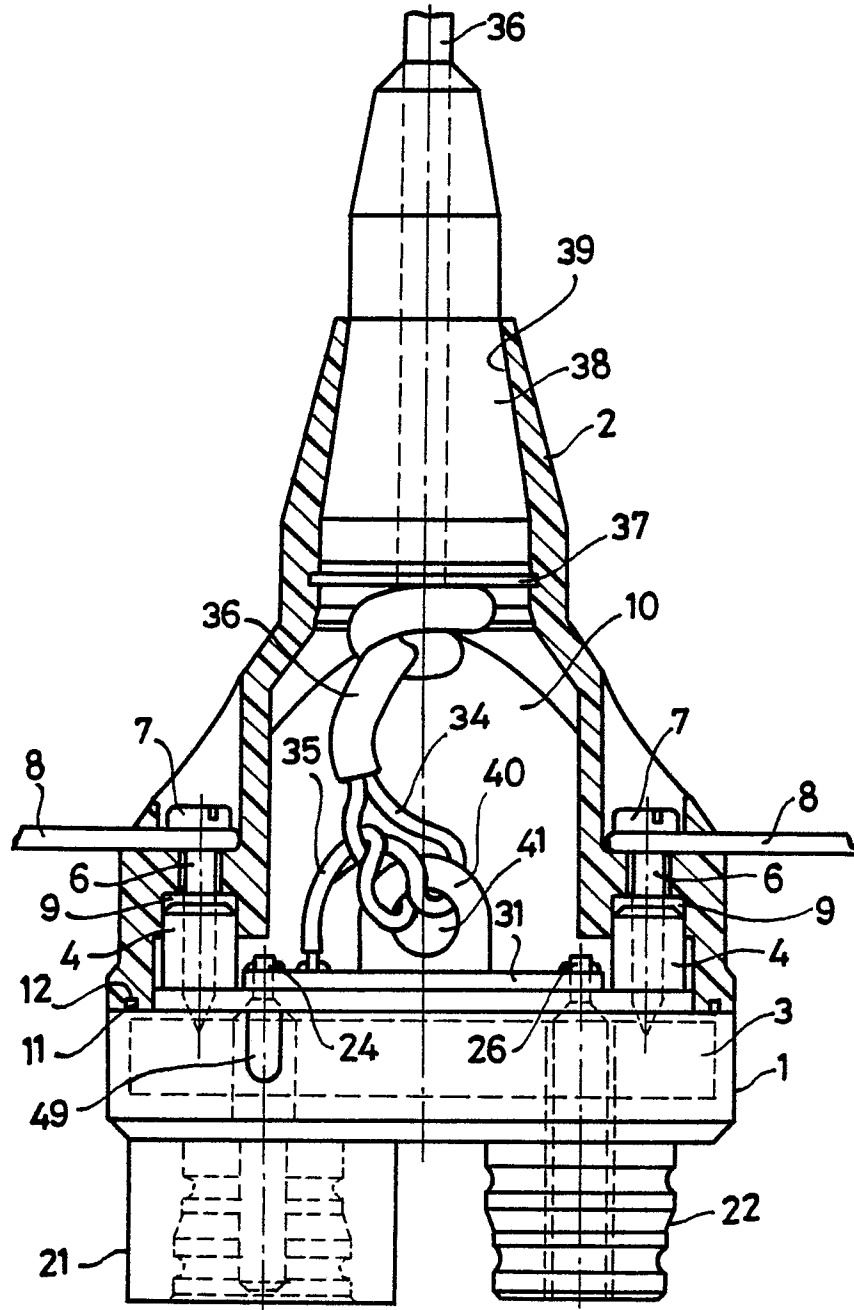
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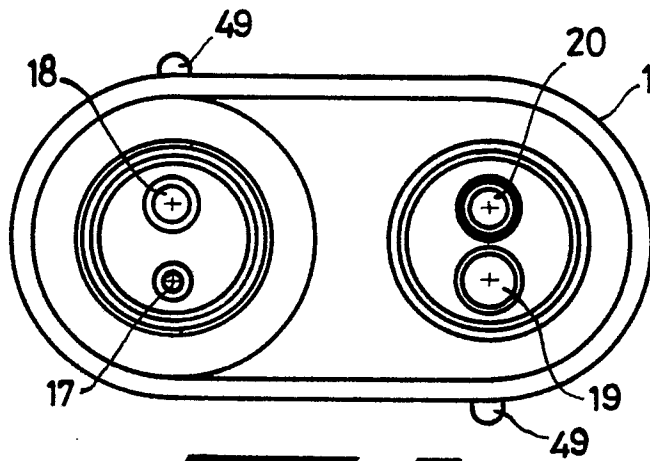
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**FIG. 1.**



**FIG. 2.**

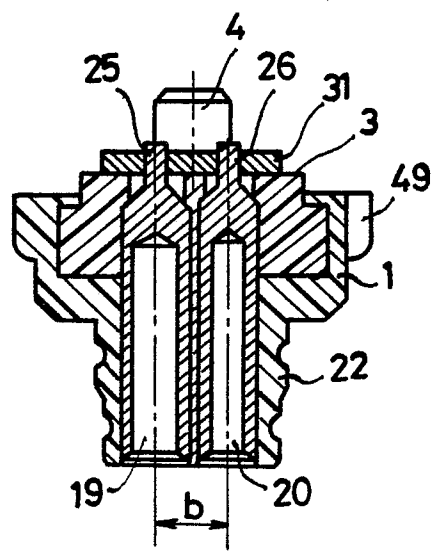
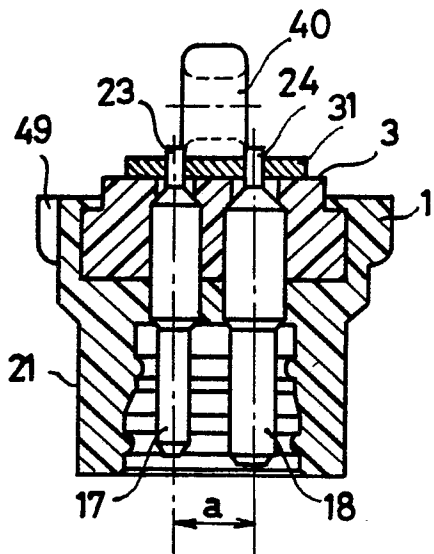
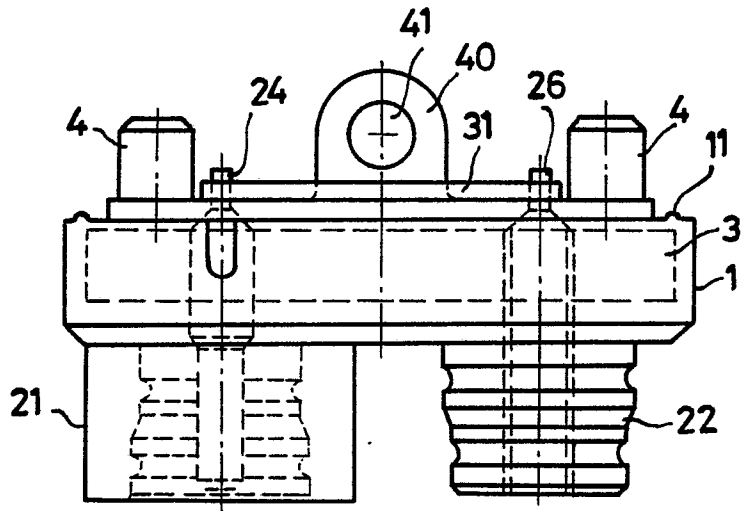
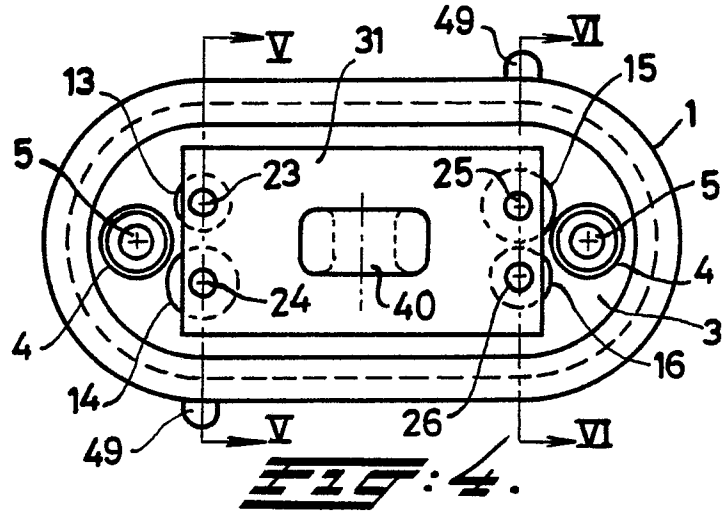
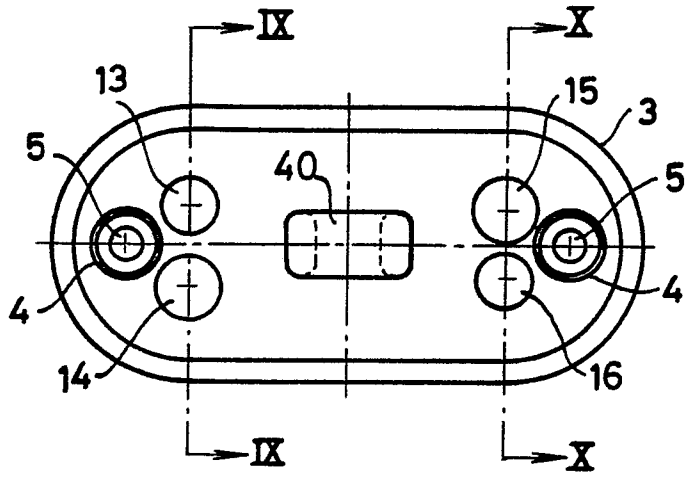
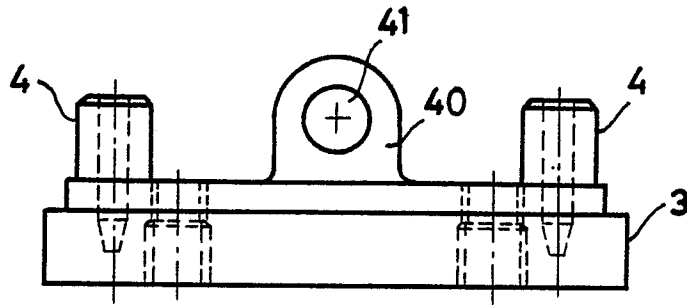


FIG. 5.

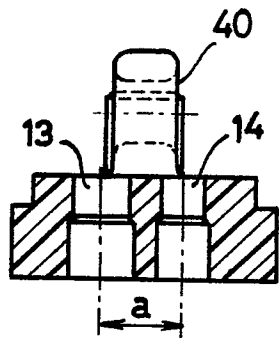
FIG. 6.



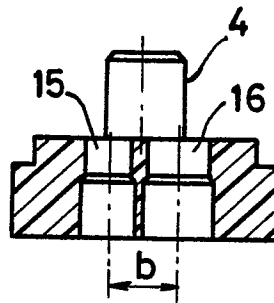
**FIG. 6.**



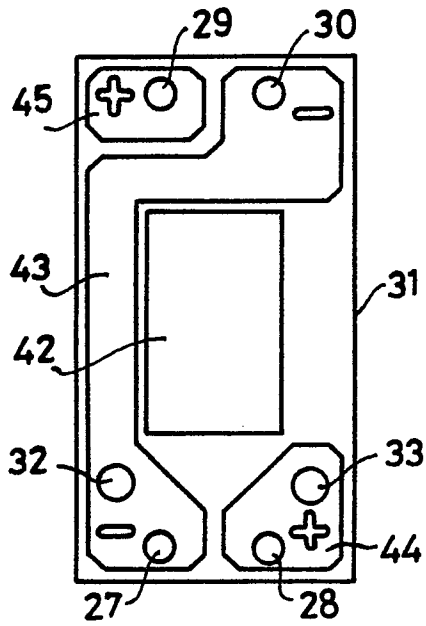
**FIG. 7.**



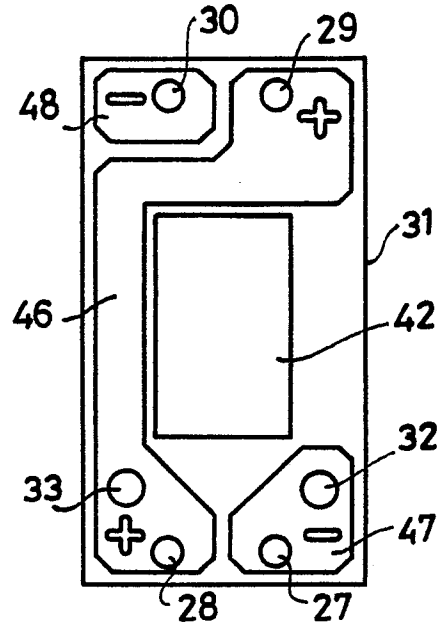
**FIG. 9.**



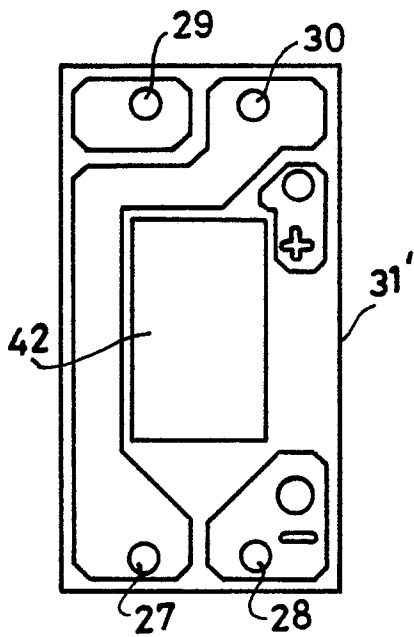
**FIG. 10.**



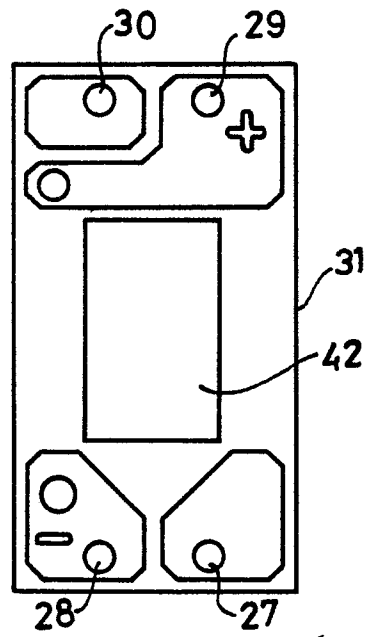
**FIG. 11.**



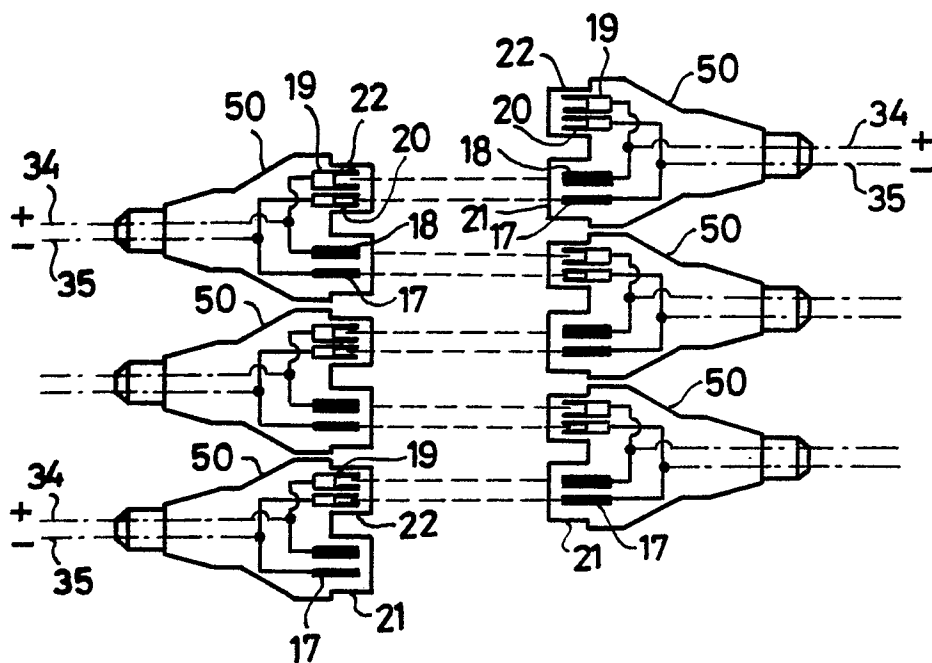
**FIG. 12.**



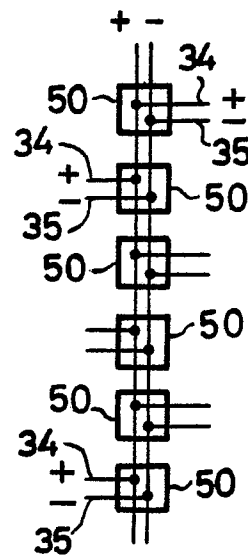
**FIG. 13.**



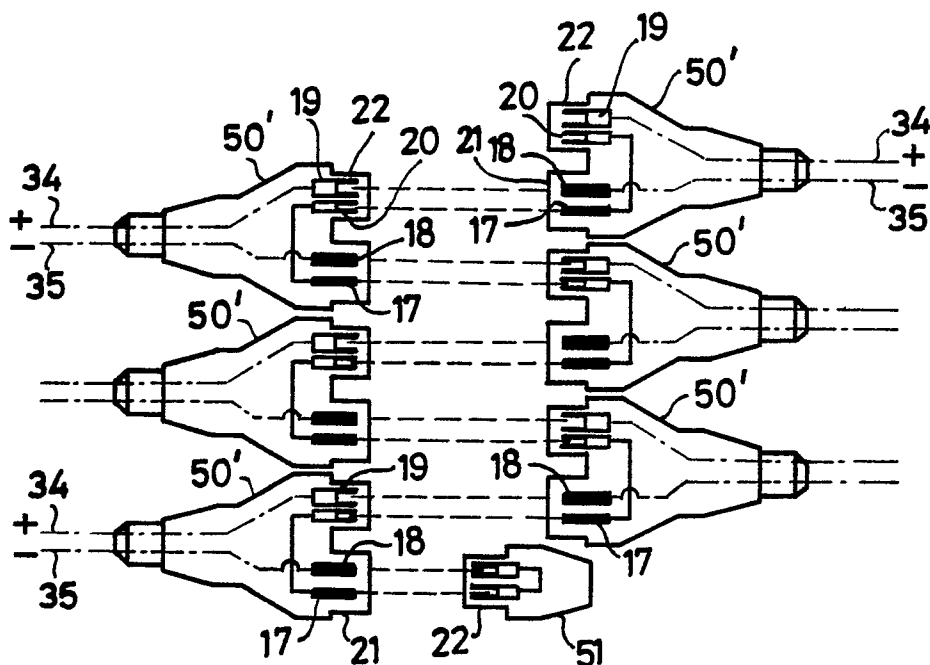
**FIG. 14.**



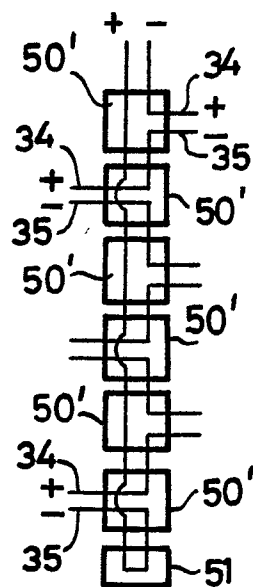
**FIG. 15.**



**FIG. 16.**



**FIG. 17.**



**FIG. 18.**



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	EP-A-0 113 465 (SIEMENS) * Page 9, lines 3-14; figure 1 *	1	H 01 R 13/66 H 01 R 13/502
A	FR-A-1 344 678 (BENDIX) * Figure 1 *	1-3	
A,D	US-A-4 445 741 (HOUSTON GEOPHYSICAL PRODUCTS) * Figures 1,9 *	1	
A	GB-A- 398 681 (BRITISH THOMSON-HOUSTON) * Figures 1-4 *	1,4	
A	US-A-2 108 907 (TE PAS) * Figures 1,2 *	1,4	
A	NL-A- 295 889 (PHILIPS) * Page 3, line 30 - page 4, line 3; figure 3 *	5	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
Place of search THE HAGUE		Date of completion of the search 08-09-1986	Examiner LOMMEL A.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone  Y : particularly relevant if combined with another document of the same category  A : technological background  O : non-written disclosure  P : intermediate document</p> <p>T : theory or principle underlying the invention  E : earlier patent document, but published on, or after the filing date  D : document cited in the application  L : document cited for other reasons  &amp; : member of the same patent family, corresponding document</p>			